RAD
data communications

Installation and Operation Manual

FOM-40

High-Speed Fiber Optic Modem

Version 2

FOM-40

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High-Speed Fiber Optic Modem

Installation and Operation Manual

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General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

Safety Symbols

Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

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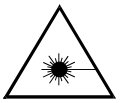
Protective earth: the marked lug or terminal should be connected to the building protective earth bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions:

- **Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.**
- **Do not attempt to adjust the laser drive current.**
- **Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.**
- **The use of optical devices with the equipment will increase eye hazard.**
- **Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.**

ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective earth terminal. If an earth lug is provided on the product, it should be connected to the protective earth at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in earthed racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Connection of AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

Connection of DC Mains

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

Connection of Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The earthing and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good earth connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the earth bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching earth ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkströrungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

Manufacturer's Address: 24 Raoul Wallenberg St.
Tel Aviv 69719
Israel

declares that the product:

Product Name: FOM-40

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022: 1994	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
	EN 50082-1 (1992)	Electromagnetic compatibility – Generic immunity standards for residential, commercial and light industry.
Safety:	EN 60950 (1992/93)	Safety of information technology equipment, including electrical business equipment.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC. The product was tested in a typical configuration.

Tel Aviv, October 6th, 1996

Haim Karshen
VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

Installation of FOM-40 should be carried out only by an experienced technician. If you are familiar with FOM-40, use this guide to set it up for operation.

This guide describes installation of the standalone version of the modem.

Perform the installation procedures for both the local and the remote units.

1. Installing FOM-40

The instructions below list the settings necessary to configure FOM-40 for proper operation. The following table lists the configuration DIP switch SW5 and its possible settings.

Configuring FOM-40

➤ **To configure FOM-40:**

1. Disconnect all the cables connected to FOM-40.
2. Set the clock source on switches SW5/6,7
   - Local FOM-40 – EXT or INT
   - Remote FOM-40 – RCV.
3. Set the baud rate on switches SW5/1-4. The baud rate must be the same for both local and remote units.
4. If you operate FOM-40 with one of the Ethernet interface modules, set the carrier to constantly ON, switch SW5/8.

Switch	Description	Values			Default Setting	
			6	**7**	**6**	**7**
CLK SEL SW5/6-7	Selects the transmit timing source	**INT** – Internal clock	OFF	OFF	OFF	OFF
		INT – Internal clock	ON	ON		
		RCV – Receive clock	OFF	ON		
		EXT – External clock	ON	OFF		
***Note**: FOM-40 units with one of the Ethernet interface modules (IR-ETH or IR-ETH/QV) do not support external clock.*						
DCD SW5/8	Selects the transmit carrier mode	**ON** – Transmit carrier is ON only if RTS is high			OFF	
		OFF – Transmit carrier is constantly ON				
***Note**: When operating FOM-40 with one of the Ethernet interface modules (IR-ETH or IR-ETH/QV) set the carrier to be constantly ON.*						
LLB, (LBE) SW5/5	Loopback activation control: Local loopback activation via DTE pin 18 for V.24, RS-530 or V.36 interface or pin "j" for V.35 interface Remote loopback activation via DTE pin 21 for V.24, RS-530 or V.36 interface or pin "h" for V.35 interface	**ON** – Loopback activation from the DTE is enabled **OFF** – Loopback activation from the DTE is disabled			OFF	

Switch	Description	Values					Default Setting
		Baud Rate [kbps]	**1**	**2**	**3**	**4**	
BAUD RATE, SW5/1–4		56	OFF	OFF	OFF	OFF	
Selects the baud rate		64	OFF	OFF	OFF	ON	64
		96	OFF	OFF	ON	OFF	
		112	OFF	OFF	ON	ON	
		128	OFF	ON	OFF	OFF	
		192	OFF	ON	OFF	ON	
		256	OFF	ON	ON	OFF	
		384	OFF	ON	ON	ON	
		512	ON	OFF	OFF	OFF	
		768	ON	OFF	OFF	ON	
		1024	ON	OFF	ON	OFF	
		1536	ON	OFF	ON	ON	
		1544	ON	ON	OFF	OFF	
		2048	ON	ON	OFF	ON	
		N/A	ON	ON	ON	OFF	
		N/A	ON	ON	ON	ON	

Connecting the Cables

Connecting the Line

➤ **To connect the fiber optic cables**

1. Remove the protective caps from the connectors and store them in a safe place for later use.
2. Connect the transmit fiber to the connector marked TX and the receive fiber to the connector marked RX.
3. At the remote unit connect the transmit fiber to RX and the receive fiber to TX.

Connecting the DTE

➤ **To connect the DTE:**

Connect the DTE cable to the appropriate FOM-40 rear panel connector.

Connecting the Power

➤ **To connect AC power to FOM-40:**

1. Connect the power cable to the power connector on the FOM-40 rear panel.
2. Connect the power cable to the mains outlet.

   The unit will be turned on automatically upon connection to the mains.

➤ **To connect DC power to FOM-40:**

Refer to DC power supply connection supplement.

2. Operating FOM-40

FOM-40 does not require operator attention once installed and configured.

Verifying Performance

When data is being transferred, observe that the following front panel LEDs light or blink:

- PWR – ON
- RTS – Blinking or ON
- TD – Blinking or ON
- RD – Blinking or ON
- DCD – ON
- ERR – OFF
- TEST – OFF.

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Appendix B. IR-ETH/QV Interface Module

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Appendix D. IR-X.21Interface Module

Chapter 1
Introduction

1.1 Overview

FOM-40 is a synchronous high-speed fiber optic modem that provides a secure, long-range data link between computers, routers, multiplexers, and other DTEs.

Versions

The following versions of the modem are available:

- FOM-40 standalone unit
- FOM-40/R: plug-in card for installation in the ASM-MN-214, 19-inch modem rack, that holds up to 14 cards.

Power Supply Options

The following power supply versions are available:

- 100 to 240 VAC
- –48 to –60 VDC
- 20 to 60 VDC

Applications

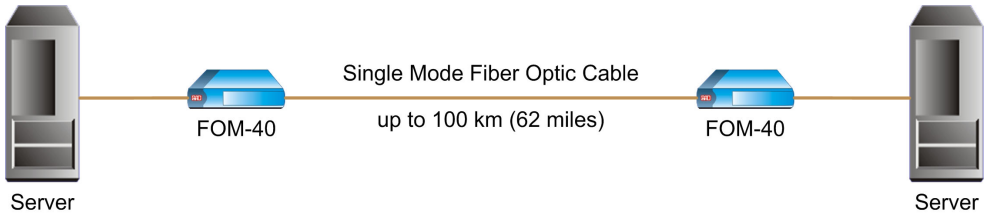

Figure 1-1. Point-to-Point Application

Figure 1-2 shows a application of FOM-40 that uses an X.21 interface adapter in a digital network tail-end configuration.

Figure 1-2. Tail-End Application for DDS Service

Features

Fiber Optic Interface

Table 1-1 lists the characteristics of the fiber optic interface types of FOM-40 and FOM-40/R, including the maximum ranges. The maximum range values given assume a margin of 3dB.

Table 1-1. Fiber Optic Interface Types

Option	Wavelength [nm]	Fiber Type [µm]	Transmitter Type	Typical Output Power [dBm]	Receiver Sensitivity [dBm]	Typical Attenuation [dB/km]	Typical Range [km]	[mi]	Connector
85	850	62.5/125 multimode	VCSEL	-18	-39	3.5	4.5	2.8	ST, FC, SC
13L	1310	9/125 single mode	Laser	-12	-40	0.5	50	31	ST, FC, SC
15L	1550	9/125 single mode	Laser	-12	-40	0.25	100	62	ST, FC, SC

DTE Interface

FOM-40 operates at the 14 selectable baud rates: 56, 64, 96, 112, 128, 192, 256, 384, 512, 768, 1024, 1536, 1544, and 2048 kbps. This includes the 1544 kbps rate for T1 and 2048 kbps rate for E1 transmission.

FOM-40 supports the following DTE interfaces:

- V.24/RS-232 (up to 64 kbps)
- RS-530
- V.35
- X.21
- V.36
- IR-G.703/CO (G.703 Codirectional, 64 kbps)

Timing

FOM-40 transmit timing can be derived either internally, or externally. Possible external sources for the transmit timing are the data terminal or the receive signal. The receive timing is always regenerated from the receive signal.

Diagnostics

FOM-40 features RLB and LLB diagnostics for performing local analog and digital loopbacks and remote digital loopback. The local analog and remote digital loopbacks are controlled by front-panel pushbuttons or by a DTE interface for V.24, V.35 and RS-530 protocols.

A front panel pushbutton generates an internal 511-bit pseudo-random test pattern (PATT), according to ITU V.52, for direct end-to-end integrity testing. When the test is running, the ERR indicator blinks for each bit error detected.

1.2 Physical Description

FOM-40 is available as a standalone unit or as a rack-mount card for the ASM-MN-214 hub. *Figure 1-3* shows a FOM-40 standalone unit.

Figure 1-3. FOM-40 Standalone Unit

Seven front panel LEDs display the status of power, data flow, control signals, and diagnostics. Four front-panel pushbuttons activate three loopbacks and BER testing. For a detailed description of the front panel, see *Chapter 3*.

The back panel includes a power connector (AC or DC), a DTE interface connector, and a line connector. The FOM-40 rear panel is described in *Chapter 2*.

DIP switches can be configured to support a variety of modes for operating the modem. Refer *FOM-40 Dip Switches* on page *4-2* for DIP switch settings.

1.3 Functional Description

This section contains functional descriptions of the FOM-40 circuit blocks shown in *Figure 1-4*.

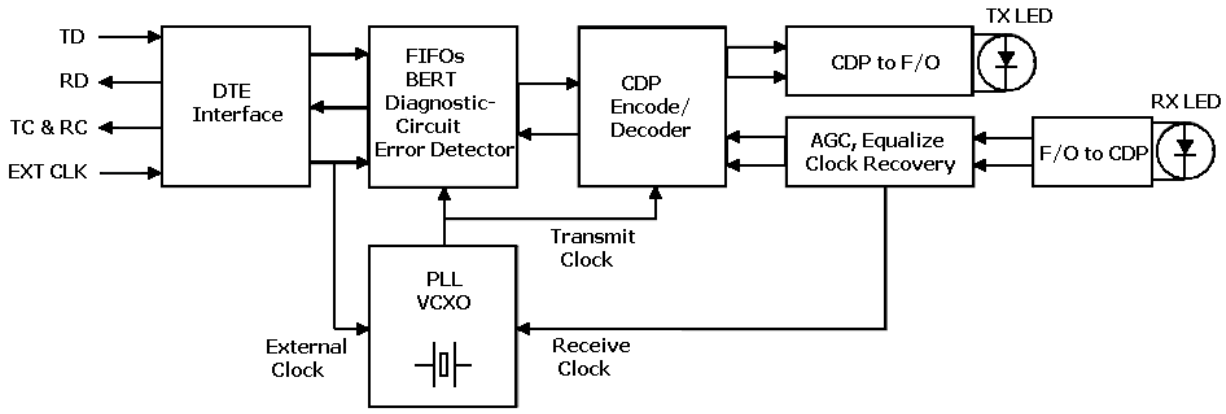

Figure 1-4. FOM-40 Block Diagram

FOM-40 provides a high-speed data link between computers, routers, or multiplexers. The electrical signals from the DTE unit are converted into an optical signal using an infrared light emitting diode. At the opposite end of the fiber, the optical signal is converted back into an electrical signal in compliance with the appropriate interface.

Timing

The modulation timing circuit supplies the transmit clock timing signal to the encoder. Three timing sources are available:

- Internal, supplied by the internal crystal oscillator
- External, derived from the DTE clock
- Receive, recovered from the received signal.

FOM-40 utilizes a Phase Locked Loop (PLL) circuit to recover jitter-free data and clock from the optical signal.

Diagnostics

FOM-40 provides remote digital loopback, local analog loopback, and local digital loopback. The loopbacks are activated manually from the front panel. Additionally, remote digital loopback and local analog loopback are activated over the DTE interface using pins ”h” and “j” of the V.35 or pins 18 and 21 of the RS-530 or RS-232. These pins are enabled or disabled separately by the DTE DIP switch (LLB and RLB).

Test Pattern Generator and Receiver

The Test Pattern Generator easily and quickly tests the local modem and the communication link. When the PATT pushbutton on the front panel is pressed, the circuit sends a standard 511-bit pseudo-random pattern and checks the response. If errors are detected, the front panel ERR LED indicator remains ON or blinks.

The test can be carried out in local analog loopback, in remote digital loopback or in normal point-to-point operation opposite a remote FOM-40 modem.

1.4 Technical Specifications

Optical Interface	*Transmission Line*	Dual fiber optical cable
	Specifications and Ranges	See *Table 1-1*
DTE Interface	*Type*	• V.24 (RS-232), 25-pin D-type, female • RS-530 (V.11/RS-422), 25-pin D-type, female • V.35, 34-pin, female • X.21, 15-pin D-type, female • V.36, 37-pin D-type, female (via adapter cable) • IR-G.703/CO (64 kbps), 5-clip terminal block or RJ-45 • IR-ETH/QV, RJ-45
	Baud Rate	56, 64, 96, 112, 128, 192, 256, 384, 512, 768, 1024, 1536, 1544, 2048 kbps (V.24: up to 128 kbps; IR-G.703/CO: 64 kbps)
Timing		Derived from 3 alternative sources: • Internal oscillator • External from the DTE • Receive clock derived from the receive signal
Diagnostics	*Loopbacks*	Local Loopback (LLB): activated by a front panel pushbutton or by the DTE interface signal (V.35, V.24, RS-530 and V.36) Remote Loopback (RLB): activated by a front panel pushbutton or by the DTE interface connector signal (V.35, V.24, RS-530 and V.36) Local Digital Loopback (DIG): activated by a front panel pushbutton
	BER Testing	Pattern generator and tester
Indicators	*TD (yellow)*	Transmit Data
	RD (yellow)	Receive Data
	RTS (yellow)	Request to Send
	DCD (yellow)	Data Carrier Detect
	TEST (yellow)	Test
	PWR (green)	Power

	ERR (red)	Error
Physical	*FOM-40/SA*	
	Height	40 mm / 1.5 in
	Width	190 mm / 7.4 in
	Depth	160 mm / 6.2 in
	Weight	0.6 kg / 1.3 lb
	FOM-40/R	Fits a single slot in the ASM-MN-214 modem rack
Power	*AC Source*	100 to 240 VAC (±10%), 50 to 60 Hz, 3VA max
	DC Source	24/–48 VDC (±10%), 4W
Environment	*Temperature*	0°–50°C / 32°–122°F
	Humidity	Up to 90%, non-condensing

Chapter 2

Installation and Setup

This chapter describes installation and setup procedures for the standalone FOM-40 modem.

FOM-40 is delivered completely assembled. It is designed for tabletop or 19-inch rack installation. For instructions on installing one or two units in a 19-inch rack, refer to the guide that comes with the rack mount kit.

To check normal operation after installing the unit, see *Chapter 3*.

For instructions on how to configure the unit, see *Chapter 4*.

For test and diagnostic instructions, see *Chapter 5*.

Warning

Internal settings, adjustment, maintenance, and repairs may be performed only by a skilled technician who is aware of the hazards involved.

Always observe standard safety precautions during installation, operation, and maintenance of this product.

2.1 Site Requirements and Prerequisites

Install an AC-powered FOM-40 within 1.5m (5 ft) of an easily accessible grounded AC outlet that supplies 100–240 VAC.

A DC-powered FOM-40 unit requires a –48 VDC or 24 VDC power source, which must be adequately isolated from the mains supply. To prevent a fire hazard, install a suitable fuse on the DC line.

Allow at least 90 cm (36 in) of clearance in the front for operating and maintenance accessibility. Allow at least 10 cm (4 in) of clearance in the rear for routing signal lines and interface cables.

Ambient operating temperature of FOM-40 is 0° to 50°C (32 to 122°F) at 90% relative humidity, non-condensing.

2.2 Package Contents

The FOM-40 package includes the following items:

- One FOM-40 or FOM-40/R unit
- Last Mile Access and Intelligent Modems CD
- CBL-530/449 adapter cable for the FOM-40 units with V.36 interface
- AC power cord or DC power supply connector kit
- RM-29 rack mount kit (if ordered).

2.3 Installing FOM-40

FOM-40 is a standalone device intended for tabletop or bench installation. It is delivered completely assembled. No provision is made for bolting the unit on the tabletop.

➤ **To install FOM-40:**

1. Set the DIP switches according to the required configuration of FOM-40.
2. Connect the line (see *Connecting the Fiber Optic Interface* below).
3. Connect the DTE (see *Connecting the DTE* below).
4. Connect power to the unit (see *Connecting the Power* below).

Warning

Access to the inside of the equipment is permitted only to authorized and qualified personnel.

To avoid accidental electric shock, always disconnect the interface cables and the power cord before removing the unit from its casing.

Line voltages are present inside FOM-40 when it is connected to power and/or the lines. Moreover, under certain fault conditions, dangerous voltages may appear on the lines connected to the unit.

Any adjustment, maintenance and repair of the opened instrument under voltage must be avoided as much as possible and, when inevitable, should be carried out only by a skilled technician who is aware of the hazard involved. Capacitors inside the unit may still be charged even after the unit has been disconnected from its source of power.

Caution FOM-40 contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components. Before setting DIP switches, touch the FOM-40 rear panel.

Connecting the Cables

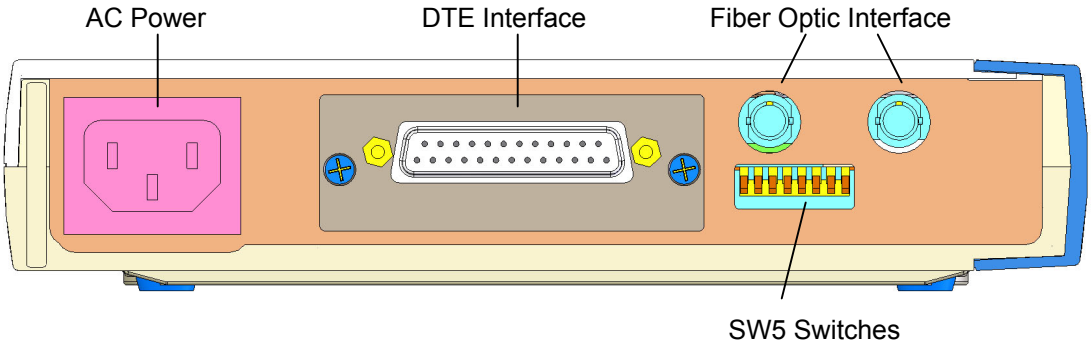

Figure 2-1. FOM-40 Rear Panel (AC Version)

Connecting the Fiber Optic Interface

Two fiber optic ST, SC, or FC connectors are located on the rear panel and marked TX and RX.

➤ **To connect the fiber optic cables**

1. Remove the protective caps from the connectors and store them in a safe place for later use.
2. Connect the transmit fiber to the connector marked TX and the receive fiber to the connector marked RX.
3. At the remote unit connect the transmit fiber to RX and the receive fiber to TX.

Connecting the DTE

The rear-panel DTE connector provides interface for data input/output, clock reference and control signal exchange between FOM-40 and the DTE. RAD offers interface cables for the DTE connection, refer to *Table 2-1* for the DTE interface connector description.

Table 2-1. DTE Interfaces and Matching Connector Cables

DTE Interface	Description	RAD Cable
V.24 (RS-232)	25-pin, D-type, female (see *Appendix A* for the connector pinout)	CBL-HBT/V24
V.35	34-pin, female (see *Appendix A* for the connector pinout)	CBL-HBT/V35
RS-530	25-pin, D-type (see *Appendix A* for the connector pinout)	CBL-HBT/RS-530
V.36	Via adapter cable converting between RS-530 connector and 37-pin, D-type, female connector (see *Appendix A* for the cable pinout)	CBL-530/449 (supplied with the unit)
IR-X21	15-pin, D-type, female (see *Appendix F* for the module description)	CBL-HBT/X21
IR-G.703/CO	5-clip terminal block or RJ-45 (see *Appendix E* for the module description)	
IR-ETH/QV	RJ-45 (see *Appendix C* for the connector pinout)	

Connecting the Power

To connect FOM-40 to the power source, refer to the appropriate section below, depending on your version of the unit (AC or DC).

Warning

Before switching on this unit and connecting any other cable, the protective earth terminals of this unit must be connected to the protective ground conductor of the mains power cord. If you are using an extension cord (power cable) make sure it is grounded as well.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting of the protective earth terminal can make this unit dangerous. Intentional interruption is prohibited.

AC Power Connection

Supply AC power to FOM-40 through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong plug. The cable is provided with the unit.

➤ **To connect AC power:**

1. Connect the power cable to the power connector on the FOM-40 rear panel.
2. Connect the power cable to the mains outlet.

   The unit turns on automatically when connected to the mains.

DC Power Connection

➤ **To connect DC power:**

Refer to DC power supply connection supplement.

Chapter 3

Operation

This chapter provides the following information for the FOM-40 standalone modem:

- FOM-40 front-panel indicators and controls
- Operating procedures.

Before operating FOM-40, complete and check all installation procedures in *Chapter 2*.

3.1 Front Panel Controls and Indicators

Figure 3-1 shows the FOM-40 front panel. *Table 3-1* lists FOM-40 controls and indicators.

Figure 3-1. FOM-40 Front Panel

Table 3-1. FOM-40 Front Panel Controls and Indicators

Name	Type	Function
PWR	Green LED	ON – Power is on.
RTS	Yellow LED	ON – The DTE activates Request To Send.
TD	Yellow LED	ON – Steady SPACE is being transmitted. Blinks – Data is being transmitted.
RD	Yellow LED	ON – Steady SPACE is being received. Blinks – Data is being received.
DCD	Yellow LED	ON – A valid receive signal is present.
TEST	Yellow LED	ON – FOM-40 is in one of three loopback modes, or the PATT pushbutton is pressed.
ERR	Red LED	ON or blinks if errors are present.
DIG	Pushbutton	Pressing the digital loopback pushbutton causes the local FOM-40 to loop received data to its transmitter (see *Figure 4-3*).
ANA	Pushbutton	Pressing the local loopback pushbutton causes the local FOM-40 to loop its transmitter output back to its receiver (see *Figure 4-1*). This loopback may also be activated from the DTE when SW5/5 is set to EN (excluding X.21, G.703 and Ethernet interfaces).
REM	Pushbutton	Pressing the remote digital loopback pushbutton causes the remote FOM-40 to loop received data to its transmitter (see *Figure 4-2*). This loopback may be also activated from the DTE when SW5/5 is set to EN (excluding X.21, G.703 and Ethernet interfaces).
PATT	Pushbutton	Pressing the PATT switch causes FOM-40 to send and receive a test pattern. If errors occur, the ERR indicator lights up.

Note *SW5/5 dip switches control the LLB and RLB activation only from the DTE interface. The jumper settings do not affect the ANA and REM pushbutton operation.*

3.2 Turning On FOM-40

When power is connected to FOM-40 it turns on, the PWR indicator lights, and remains lit as long as the unit receives power.

FOM-40 requires no operator attention once installed, except for occasionally monitoring front panel indicators. Intervention is required only when the modem is configured to new operational requirements, or diagnostic tests are performed.

3.3 Normal Indications

Table 3-2 shows the correct status of the FOM-40 indicators after the local and remote modem are synchronized and data is being transferred.

Table 3-2. FOM-40 Indicator Status

Indicator	Status
PWR	ON
RTS	Blinking or ON
TD	Blinking or ON
RD	Blinking or ON
DCD	ON
ERR	OFF
TEST	OFF

If the LEDs do not reflect the above status, check that:

- One modem is set to internal or external clock, and the other to receive clock.
- All four front-panel pushbuttons are in the OFF position.

3.4 Turning Off FOM-40

To turn off the modem, unplug the power cord from the power source.

Chapter 4

Configuration

This chapter contains the following information for the FOM-40 standalone modem:

- Configuration procedure for the modem
- How to set the front panel DIP switches.

4.1 Configuring FOM-40

This section describes how to configure FOM-40. *Section 4.2* provides details on the functions of the DIP switches, and their default settings.

➤ **To configure FOM-40:**

1. Disconnect all the cables connected to FOM-40.
2. Set the clock source on switches SW5/6,7
   - Local FOM-40 – EXT or INT
   - Remote FOM-40 – RCV.
3. Set the baud rate on switches SW5/1-4. The baud rate must be the same for both local and remote units.
4. If you operate FOM-40 with one of the Ethernet interface modules, set the carrier to constantly ON, switch SW5/8.

4.2 FOM-40 Dip Switches

The following FOM-40 rear panel illustrates the DIP switches that allow you to select the transmit timing source and carrier mode, baud rate, and control loopbacks. *Table 4-1* lists and explains the functions of all the DIP switches.

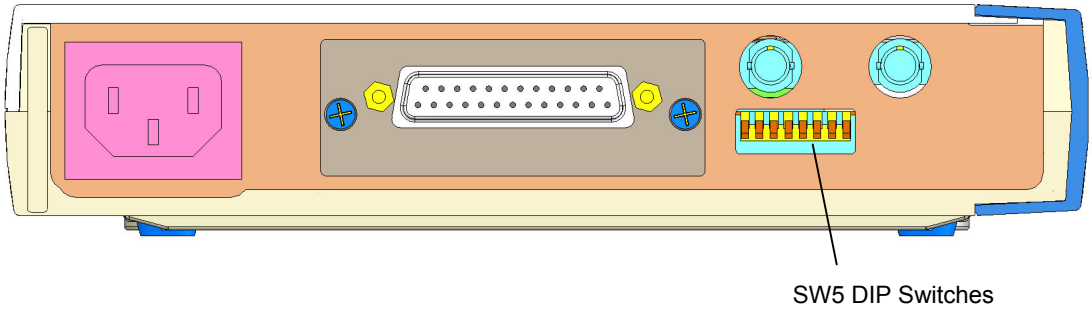

Figure 4-1. FOM-40 Rear Panel

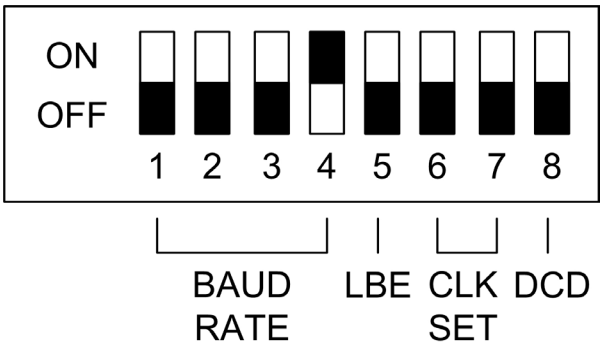

Figure 4-2. SW5 DIP Switches

Table 4-1. FOM-40 DIP Switches Settings

Switch	Description	Values			Default Setting	
			6	**7**	**6**	**7**
CLK SEL switches SW5/6-7	Selects the transmit timing source	**INT** – Internal clock	OFF	OFF	OFF	OFF
		INT – Internal clock	ON	ON		
		RCV – Receive clock	OFF	ON		
		EXT – External clock	ON	OFF		
***Note**: FOM-40 units with one of the Ethernet interface modules (IR-ETH or IR-ETH/QV) do not support external clock.*						
DCD, SW5/8	Selects the transmit carrier mode	**ON** – Transmit carrier is ON only if RTS is high			OFF	
		OFF – Transmit carrier is constantly ON				
***Note**: When operating FOM-40 with one of the Ethernet interface modules (IR-ETH or IR-ETH/QV) set the carrier to be constantly ON.*						
LLB, (LBE) SW5/6	Loopback activation control: Local loopback activation via DTE pin 18 for V.24, RS-530 or V.36 interface or pin "j" for V.35 interface Remote loopback activation via DTE pin 21 for V.24, RS-530 or V.36 interface or pin "h" for V.35 interface	**ON** – Loopback activation from the DTE is enabled **OFF** – Loopback activation from the DTE is disabled			OFF	

Table 4-1. FOM-40 Dip Switches Settings (Cont.)

Switch	Description	Values					Default Setting
		Baud Rate [kbps]	**1**	**2**	**3**	**4**	
BAUD RATE, SW5/1–4		56	OFF	OFF	OFF	OFF	
Selects the baud rate		64	OFF	OFF	OFF	ON	64
		96	OFF	OFF	ON	OFF	
		112	OFF	OFF	ON	ON	
		128	OFF	ON	OFF	OFF	
		192	OFF	ON	OFF	ON	
		256	OFF	ON	ON	OFF	
		384	OFF	ON	ON	ON	
		512	ON	OFF	OFF	OFF	
		768	ON	OFF	OFF	ON	
		1024	ON	OFF	ON	OFF	
		1536	ON	OFF	ON	ON	
		1544	ON	ON	OFF	OFF	
		2048	ON	ON	OFF	ON	
		N/A	ON	ON	ON	OFF	
		N/A	ON	ON	ON	ON	

Chapter 5

Troubleshooting and Diagnostics

This chapter contains procedures for performing FOM-40 diagnostic tests. Use the test procedures provided in this chapter to:

- Verify normal system operation
- Isolate faulty equipment
- Identify other sources of system malfunction.

The tests are activated by control pushbuttons on the FOM-40 front panel and monitored with LED indicators. For a description of FOM-40 controls and indicators and their functionality, see *Chapter 3*.

5.1 Loopback Tests

FOM-40 supports several types of loopback tests for evaluating the operation of the data system equipment and its line circuits. Using these loopbacks, you can test communication between the attached equipment, and internal circuitry of the local and remote modems.

Loopback tests are best performed in the following order:

1. Local analog loopback
2. Remote digital loopback
3. Local digital loopback.

Before testing the operation of the data system equipment and line circuits, ensure that all the units are powered up and configured properly.

Note *If you want to run the LLB and RLB tests via the DTE interface pins, ensure that switch SW5/5 is set to ON (see Table 2-1 and Figure 2-1). LLB and RLB activation through the DTE interface pins is not available for the X.21, G.703 and Ethernet interfaces.*

Note *When you send a remote loopback pattern (V.54) through the DTE, the local FOM-40 unit may go into a digital loopback as well. To avoid this, ensure that switch SW6/2 on the local modem is set to ON and switch SW6/1 on both units are set to ON.*

Local Analog Loopback (LLB)

The local analog loopback (LLB) test checks the performance of the local FOM-40 modem, the local DTE, and the connections between them (see *Figure 5-1*). The test is performed separately at the local and the remote site.

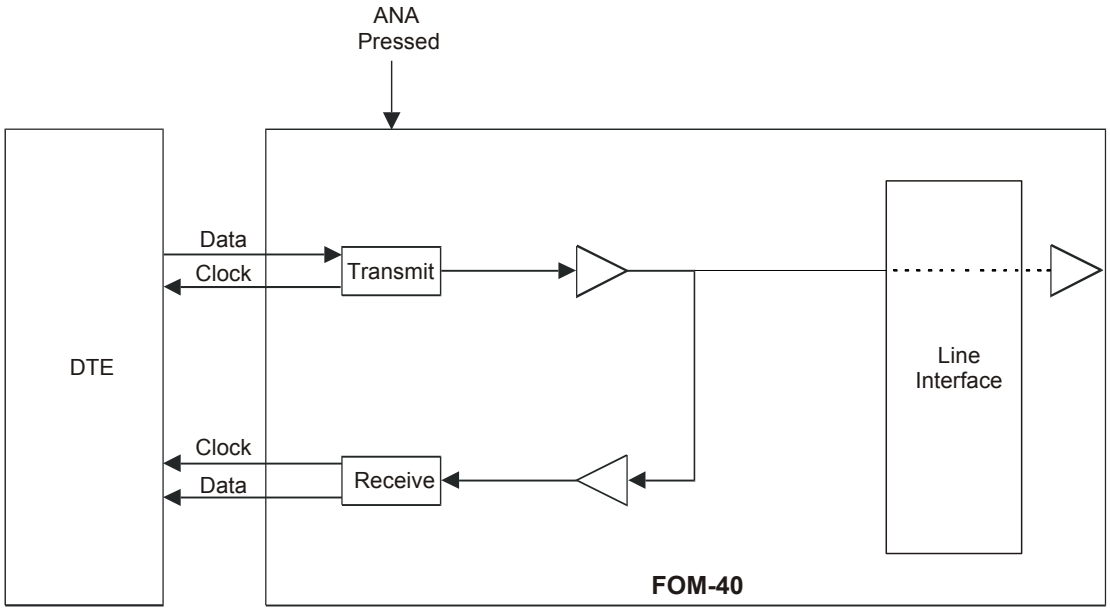

Figure 5-1. Local Analog Loopback

➤ **To perform the local analog loopback test:**

1. Press the ANA pushbutton.

   The TEST LED on the FOM-40 front panel lights up. The modem's transmit output is now connected to its own receiver.

2. Execute the local analog loopback with one of the following methods:
   - Configure the DTE to half-duplex operation and check the echoed data stream.
   - Use an external BER tester to perform a BER test.

     If the BER test indicates an error-free data stream, but the DTE test indicates a fault, check that the cable between the DTE and FOM-40 is properly connected. If the problem persists, follow the DTE manufacturer's test procedures.

3. To isolate a communication line problem, perform the LLB loopback at the opposite end. If both LLB tests are error-free, the fault is probably in the communication line or in the line interfaces.

4. After completing the test or correcting the fault, press ANA pushbutton again to restore it to the OFF position.

Remote Digital Loopback (RLB)

The remote digital loopback (RLB) test checks the performance of the local and the remote FOM-40 units and their connecting lines. The remote digital loopback sets a loop at the remote FOM-40 unit from the DTE connected to the local unit (see *Figure 5-2*).

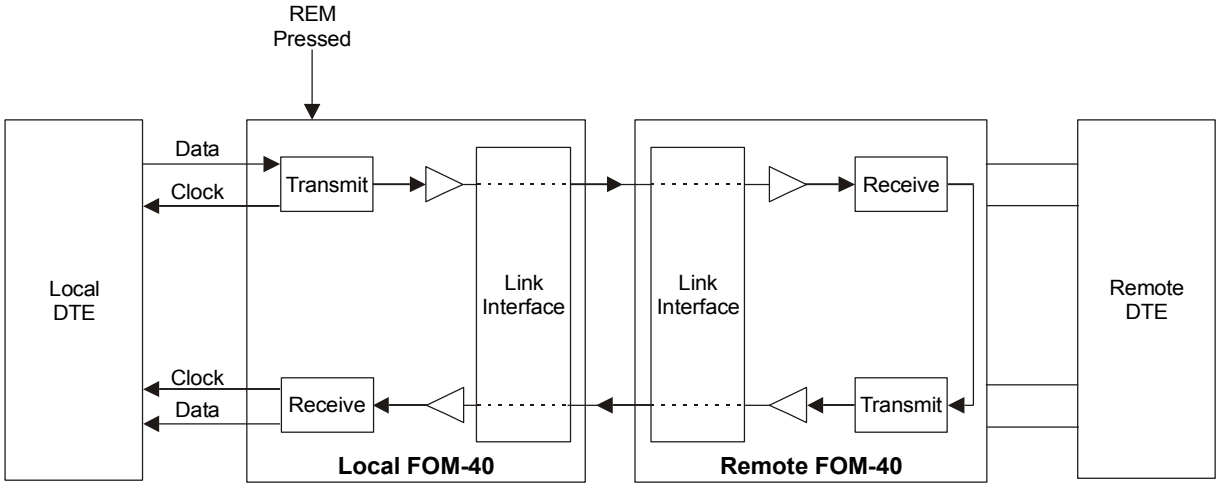

Figure 5-2. Remote Digital Loopback

➤ **To activate the remote digital loopback:**

1. Press the REM pushbutton on the local FOM-40 front panel.

   The TEST LED on each FOM-40 front panel lights up. The receive output of the remote modem is looped back to the transmitter.

2. Perform the BER test as explained above for the local analog loopback test.

   If the local analog loopback test described above was successful for both the local and remote modems, and an error occurs during the BER test, the line or the line circuits of the local or the remote unit are not operating properly.

3. After completing the test or correcting the fault, press REM pushbutton again to restore it to the OFF position.

Local Digital Loopback (DIG)

The local digital loopback (DIG) test allows the operator at the remote end to check the performance of the local and remote FOM-40 units, and their connecting lines. The DIG test loops the received data back to the remote FOM-40 (see *Figure 5-3*). The local digital loopback test is equivalent to activating the remote loopback from the remote FOM-40.

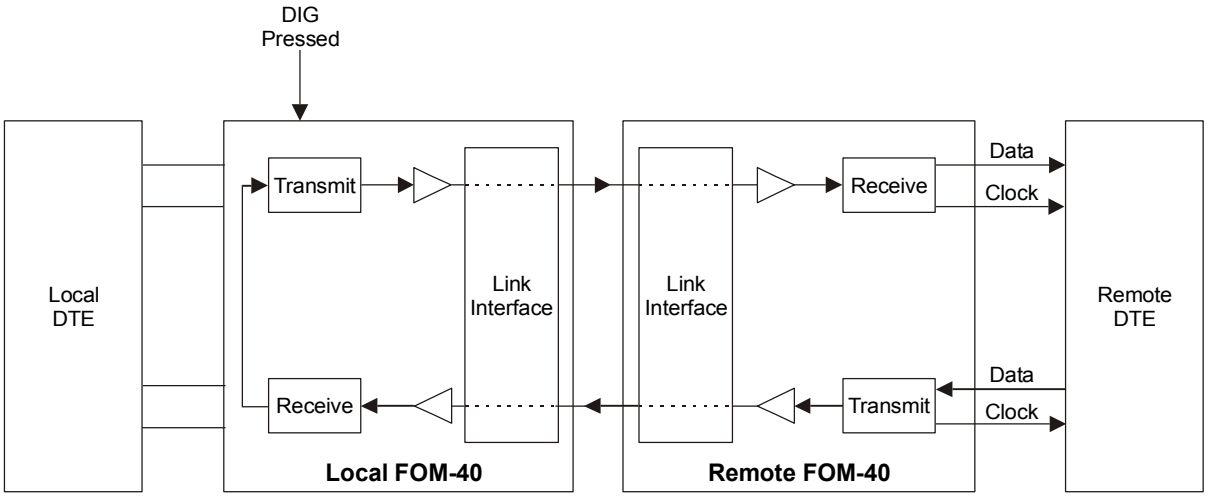

Figure 5-3. Local Digital Loopback

➤ **To activate the local digital loopback:**

- Press the DIG pushbutton on the local FOM-40 front panel.

  The TEST LED lights up.

5.2 Internal BERT

FOM-40 has a built-in BERT circuit consisting of a pattern generator and a pattern tester. This circuit acts in conjunction with the diagnostic loops and a remote BERT to verify normal system operation and isolate faulty equipment in the event of system failure. The pattern transmitted is a RAD proprietary, pseudo-random pattern.

The FOM-40 built-in BERT circuit can be used for the following tests:

- Modem Self-Test: the pattern transmitted by the pattern generator is looped back to the pattern tester for comparison (see *Figure 5-4*).
- Two-BER Test: the pattern transmitted by the BERT is received by another FOM-40 unit (see *Figure 5-5*).

Modem Self-Test

The modem self-test checks that the modem is operating correctly (see *Figure 5-4*).

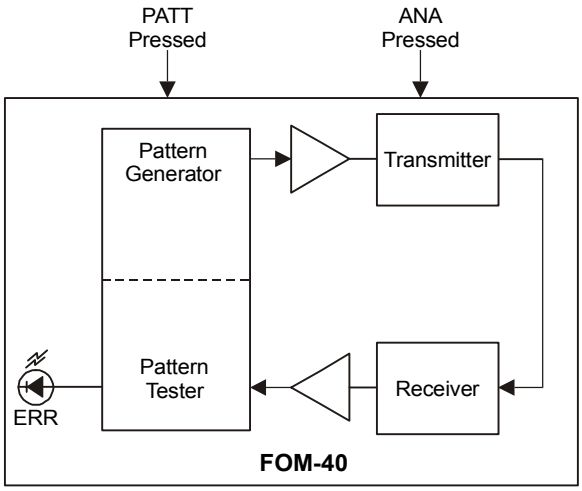

Figure 5-4. Modem Self-Test

➤ **To perform the modem self-test:**

1. Press the ANA pushbutton on the front panel.

   The TEST and DCD LEDs light.

Note *If the DCD indicator does not light, verify that the DCD switch SW5/8 is set to ON, or that the RTS signal is High.*

2. Press the PATT pushbutton. Verify that:
   - DCD and TEST LEDs are ON.
   - ERR LED blinks once.

   Continuous errors cause the ERR LED to light and stay lit, intermittent errors cause ERR to blink. FOM-40 is faulty and should be replaced.
3. To stop the test, restore all pushbuttons to their normal positions.

Two-BER Test

The Two-BER Test checks the link between the units (see *Figure 5-5*).

➤ **To perform the two-BER test:**

- Press the PATT button on both devices.

  Continuous errors cause the ERR LED to light and stay lit, intermittent errors cause ERR to blink. FOM-40 is faulty and should be replaced.

Note *For correct operation of the BER Test, the DCD switch (SW5/8) must be set to OFF or the RTS signal must be High.*

When the PATT pushbutton is pressed, the external BERT is effectively disconnected.

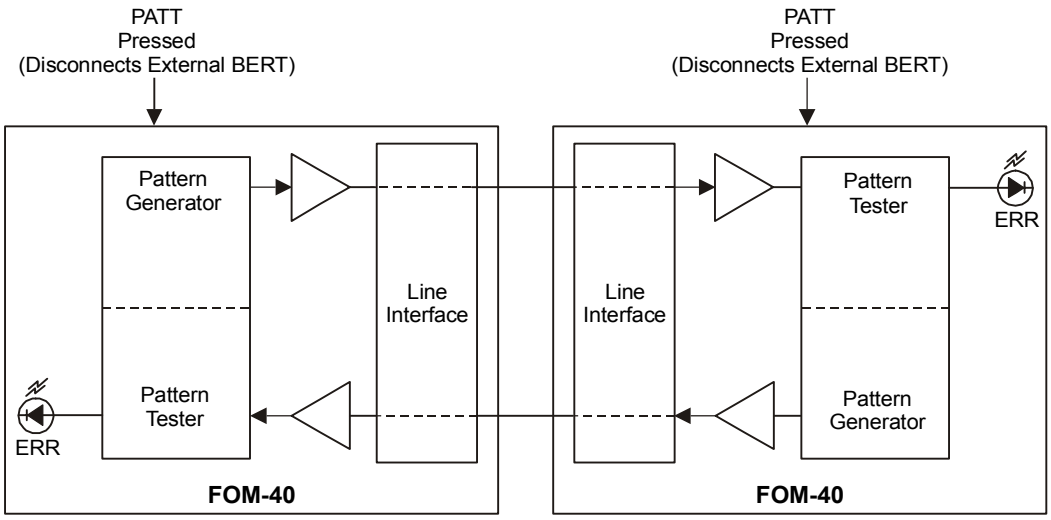

Figure 5-5. BER System Test (Two-BER Test)

5.3 Inverting Signal for V.54 Compatibility

In FOM-40 a proprietary protocol inverts signal data relative to a regular V.54. The new version of FOM-40 allows you to reinvert the signal data, to ensure compatibility with V.54.

Note *Signal inversion is not available on older V.54 units. If one of your units, either local or remote, is an older version, do not invert the signal data on the newer unit, to ensure compatibility with the older unit.*

➤ **To invert the signal for V.54 compatibility:**

1. Open the local FOM-40 and set switches SW6/1–2 to ON. Close the unit.
2. Open the remote FOM-40 and set switch SW6/1 to ON. Close the unit.

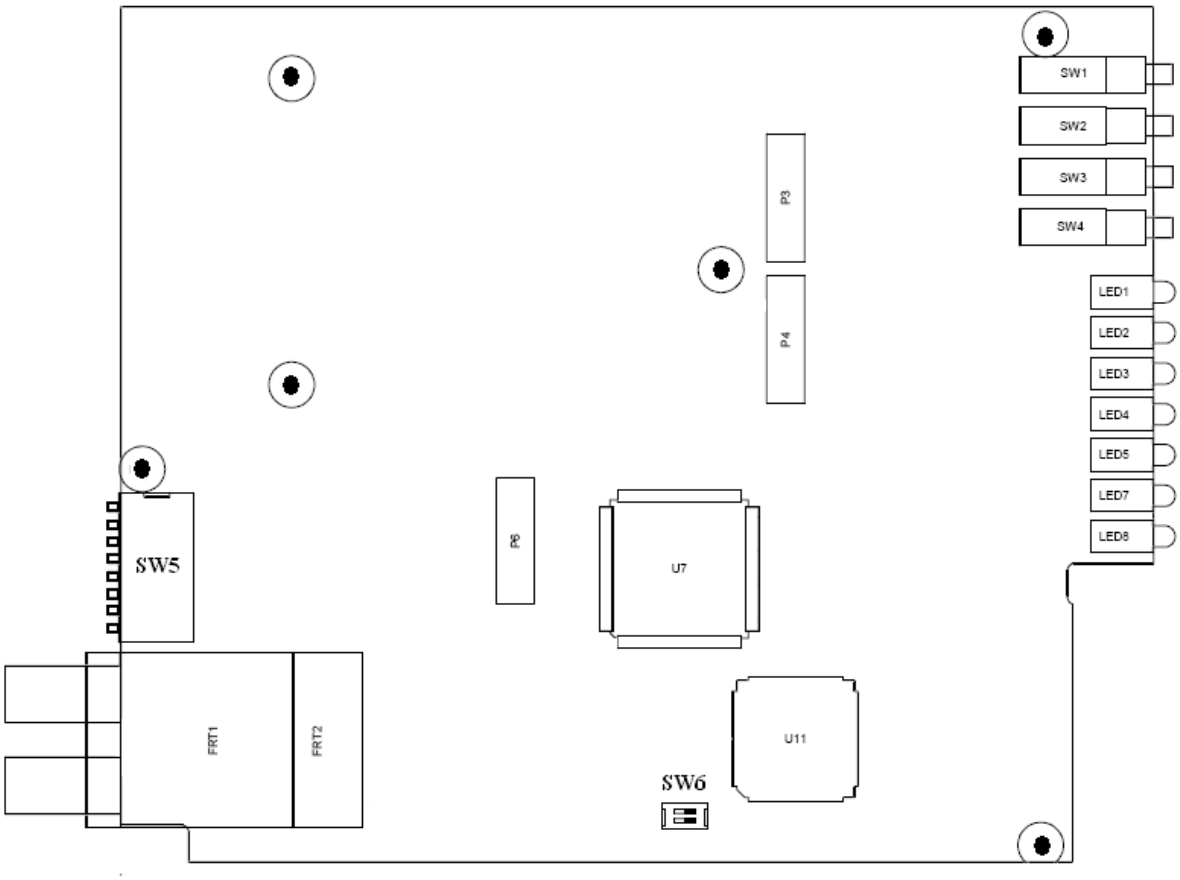

Figure 5-6. Switch SW6/1 Inverts Signal Data

5.4 Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide. This information can be found at www.rad.com (offices – About RAD > Worldwide Offices; distributors – Where to Buy > End Users).

Chapter 6

FOM-40/R Card

This chapter describes the FOM-40/R card, designed for installation in the ASM-MN-214 card cage. The chapter contains the following sections:

- The ASM-MN-214 card cage
- ASM-MN-214 power supply
- FOM-40/R front panel
- Installing the FOM-40/R card.

6.1 ASM-MN-214 Card Cage

The ASM-MN-214 card cage contains one or two power supplies and up to 14 plug-in cards. The card types can be FOM-40/R or other RAD rack version modems or converters – any combination of up to 14 plug-in cards.

For each of the 14 cards, the rear panel (see *Figure 6-1*) contains a male connector for the terminal block and a DB-25 connector. A protection cover protects the terminal block connectors.

Line Connector

The terminal block (see *Figure 6-1*) is attached to the rear panel terminal block connectors. It contains screws for connecting the transmit and receive pairs and ground, if present.

The ASM-MN-214 card cage is also available with BNC coaxial unbalanced line connectors.

Note

FOM-40/R fiber optic connectors are located on the front panel of the modem card.

DB-25 DTE Connector

The 25-pin D-type female interface connector provides all interface signals for the digital interfaces. Modems having X.21 or V.35 interfaces require an external mechanical adapter. Two optional interface attachments, CIA/X21/1 and CIA/V.35/1, can be ordered separately from RAD. CIA/X.21/1 converts one DB-25 connector to an X.21 15-pin connector. CIA/V.35/1 converts one DB-25 connector to a V.35 34-pin connector.

V.36 modem cards are supplied with a RAD adapter cable CBL-530/449F, which converts between the DB-25 connector and a V.36 37-pin connector.

FOM-40/R with one of the Ethernet interfaces (IR-ETH or IR-ETH/QV) uses a CIA/ETH interface adapter, which converts one DB-25 connector to an RJ-45 connector.

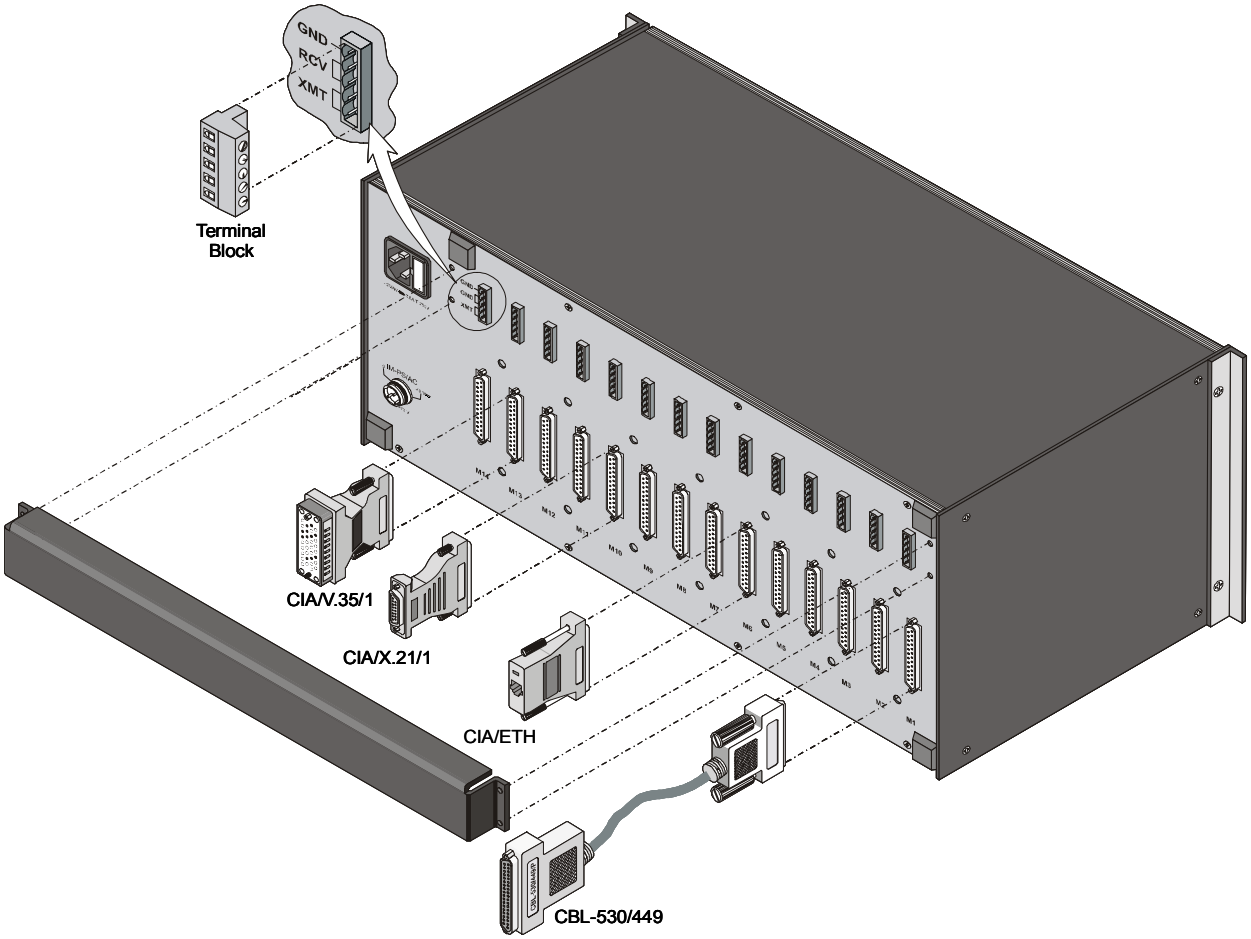

Figure 6-1. ASM-MN-214 Rear Panel

6.2 Power Supply

Power is supplied to the FOM-40/R card from the ASM-MN-214 power supply through the chassis. FOM-40/R card has two fuses (F1 and F2), which protect the entire system against power failure resulting from a short circuit in one card (see *Figure 6-1*). The rating of the fuses is 1A, 250V, slow blow.

The ASM-MN-214 card cage can accept both AC or DC power supplies. LED indicators located on the ASM-MN-214 front panel (see *Figure 6-3*) show activity when the power supply is connected to the mains plug. The power supply supports the full card cage with any combination of cards.

AC Supply

The AC power supply of the ASM-MN-214 is 100, 115, or 230 VAC, ±10%, 47 to 63 Hz.

DC Supply

The DC power supply is -48 VDC (-36 to -72 VDC) or 24 VDC (18 to 32 VDC). It uses a DC/DC converter module to provide the power required for the cards.

Power Supply with Redundancy

This option provides two separate power supplies that operate together and share the load of the whole card cage. If either of the power supplies fails, the other one continues to supply power to the full card cage.

Two LED indicators show activity of each power supply. They both light when mains power is provided.

Note *Both AC and DC power supplies can be combined in the same cage.*

6.3 FOM-40/R Front Panel

Figure 6-2 shows the FOM-40/R card front panel. The LEDs and pushbuttons of the card version are identical in their functionality to those of the standalone device. For this information, see *Front Panel Controls and Indicators* in Chapter 3.

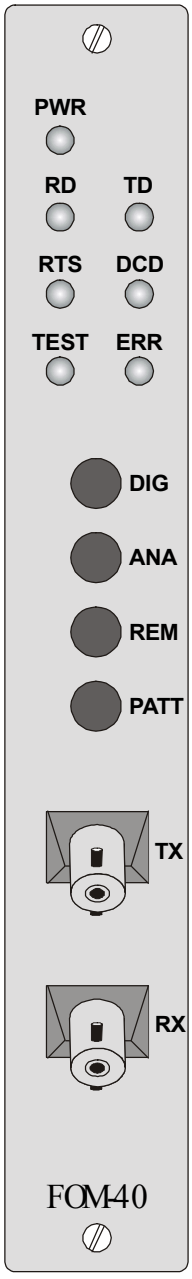

Figure 6-2. FOM-40/R Front Panel

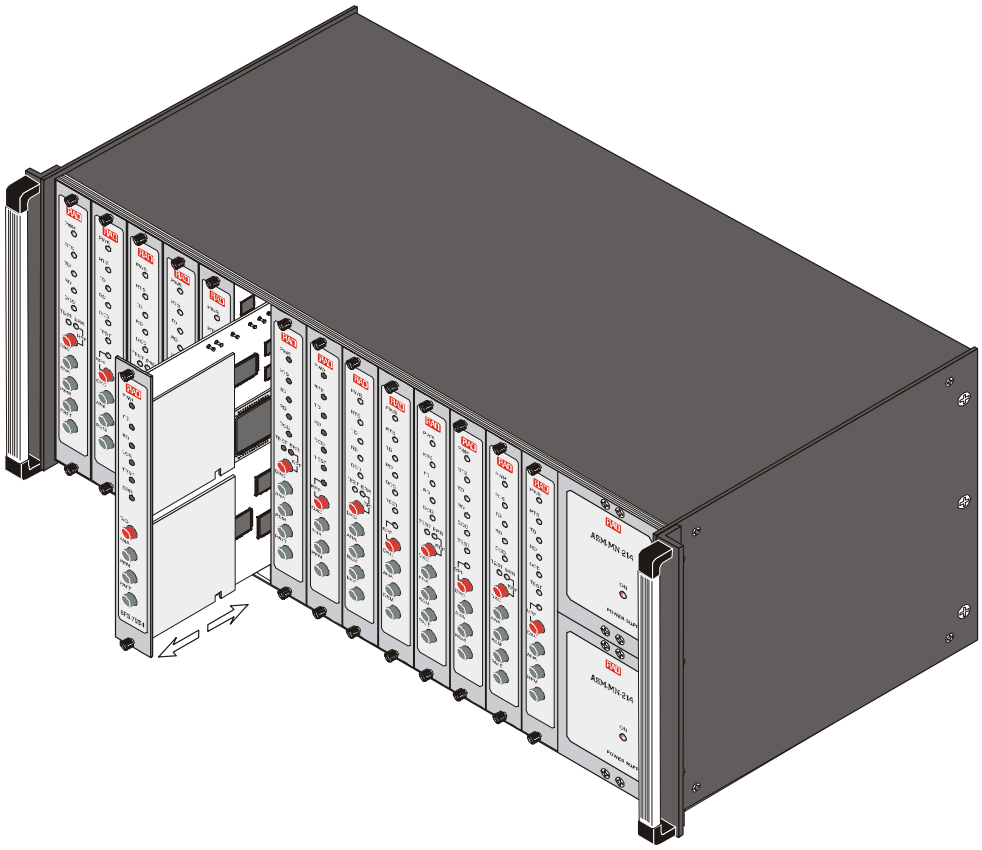

Figure 6-3. ASM-MN-214 Front Panel

6.4 Installing the FOM-40/R Card

Setting Internal Jumpers and Switches

The FOM-40/R internal jumpers and switches are illustrated in *Figure 6-4*. *Table 6-1* details the jumper and switch settings.

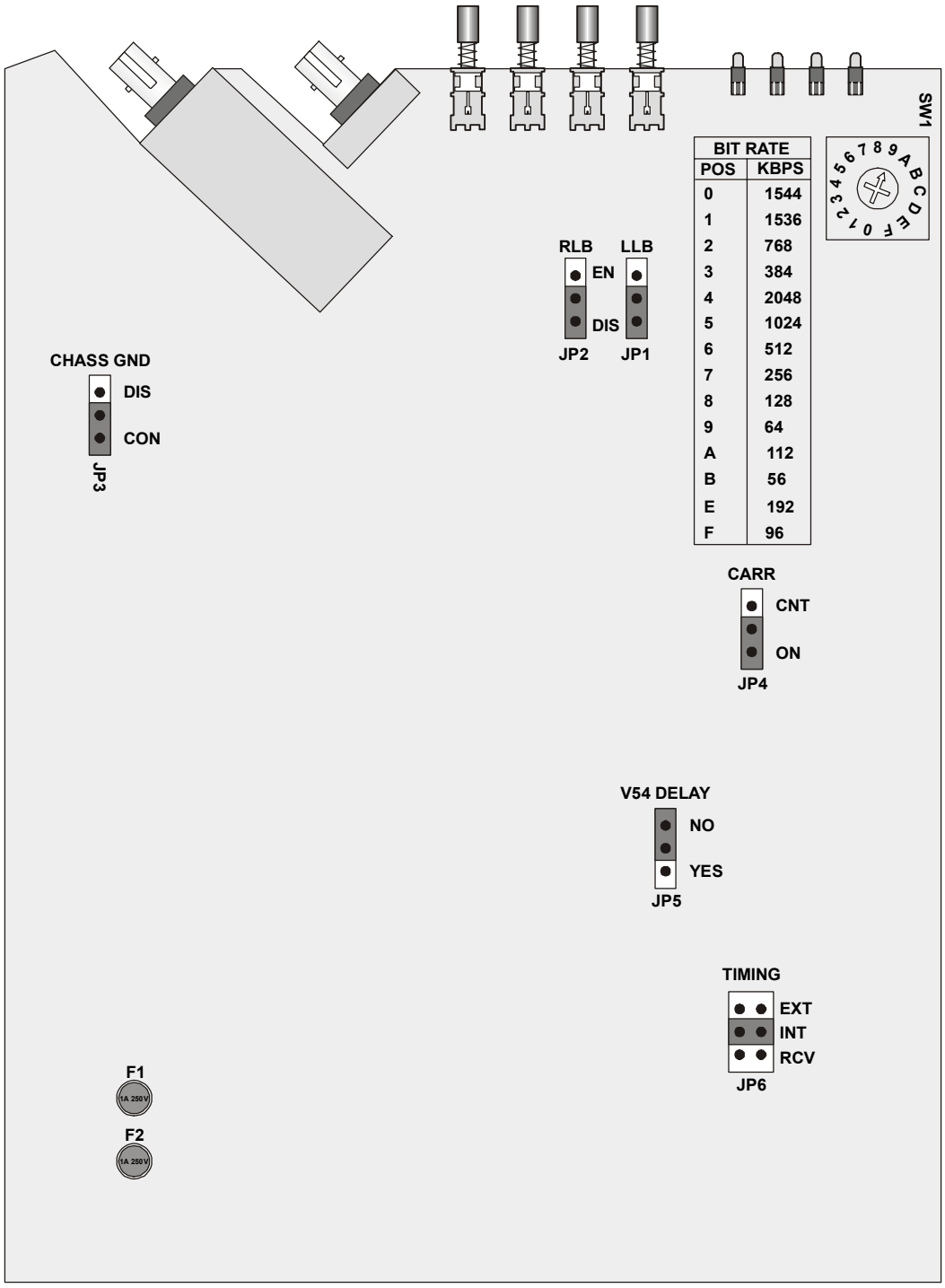

Figure 6-4. FOM-40/R PCB Layout

Table 6-1. FOM-40/R Internal Jumpers and Switches

Jumper	Description	Values	Default Setting
TIMING, JP6	Selects the transmit timing source	**EXT** – External clock	
		INT – Internal clock	INT
		RCV – Receive clock	
***Note**: FOM-40/R cards with one of the Ethernet interface modules (IR-ETH or IR-ETH/QV) do not support external clock.*			
CARR, JP2	Selects the transmit carrier mode	**ON** – Transmit carrier is constantly ON	ON
		CNT – Transmit carrier is ON only if RTS is high	
***Note**: When operating FOM-40 with one of the Ethernet interface modules (IR-ETH or IR-ETH/QV) set the carrier to be constantly ON.*			
V54 DELAY, JP5	Controls V.54 delay to prevent multiple loopback in tail-end applications	**YES** – V.54 delay is enabled	
		ON – V.54 delay is disabled	NO
CHASS GND, JP3	Controls the connection between the FOM-40 signal ground and the frame (chassis) ground.	**CON** – Signal ground is connected to the frame ground	CON
		DIS – Signal ground is disconnected from the frame ground	
***Note**: Disconnecting the signal ground from the frame ground may render the unit unsafe for connection to unprotected telecommunication networks in some locations.*			
LLB, JP1	Controls the analog loopback activation via the DTE pin 18 for V.24, RS-530 or V.36 interface or pin "j" for V.35 interface	**EN** – The analog loopback activation from the DTE is enabled	EN
		DIS – The analog loopback activation from the DTE is disabled	
RLB, JP2	Controls the remote loopback activation via the DTE pin 21 for V.24, RS-530 or V.36 interface or pin "h" for V.35 interface	**EN** – The remote loopback activation from the DTE is enabled	EN
		DIS – The remote loopback activation from the DTE is disabled	
BAUD RATE, SW1	Selects the data rate in kbps.	**0** – 1544 kbps	
		1 – 1536 kbps	
		2 – 768 kbps	
		3 – 384 kbps	
		4 – 2048 kbps	4 for E1
		5 – 1024 kbps	
		6 – 512 kbps	
		7 – 256 kbps	
		8 – 128 kbps	
		9 – 64 kbps	9
		A – 112 kbps	
		B – 56 kbps	
		E – 192 kbps	
		F – 92 kbps	

Note *Jumpers JP1 and JP2 control the LLB and RLB activation from the DTE interface only. The jumper settings do not affect the ANA and REM pushbutton operation.*

Installing FOM-40/R into the ASM-MN-214 Card Cage

➤ **To install the FOM-40/R card in the ASM-MN-214 card cage:**

1. Install the ASM-MN-214 card cage in the 19-inch rack.
2. Insert the FOM-40/R card into one of the ASM-MN-214 slots.
3. Push the card into the cage until it is fully inserted into the edge connector inside the rack.
4. Tighten the screws on front panel of the modem card.

Connecting the Interfaces

The ST, SC, or FC fiber optic connectors are located on the front panel of the modem card. The 25-pin D-type female connectors located on the rear panel of the ASM-MN-214 rack serve as a DTE ports.

1. Remove the protective caps from the connectors and store them in a safe place for later use.
2. Connect the transmit fiber to the connector marked Tx and the receive fiber to the connector marked Rx.
3. At the remote unit connect the transmit fiber to Rx and the receive fiber to Tx.
4. If required, attach the appropriate CIA (CIA/X.21/1, CIA/V.35/1, CIA/ETH) or V.36 adapter cable to the DB-25 connector on the card cage rear panel.
5. Connect the DTE cable to the DB-25 connector, other side of CIA or adapter cable (depending on your version of the card interface).
6. Connect power to the ASM-MN-214 card cage:
   - To connect AC power, connect the power cable to the mains supply.
   - To connect DC power, refer to DC power supply connection supplement of the ASM-MN-214 installation and operation manual.

Warning

The ASM-MN-214 card cage has no power switch. Operation starts when the power is applied to the rear panel POWER connector. When applying power, first connect the plug of the power cord to the ASM-MN-214 POWER connector and then to the mains power source (outlet).

Appendix A
Connector Wiring

A.1 V.24, V.35 and X.21 Interface Connectors

Table A-1 describes the signal assignments for the FOM-40 V.24, V.35 and X.21 DTE interface connectors.

Table A-1. DTE Interface Signal Assignments

Signal Function	V.24	V.35		X.21		Description
	DB-25 Standalone and Card Cage	DB-25 Card Cage	34-Pin Standalone Pin Circuit	DB-25 Card Cage	DB-15 Standalone Pin Circuit (Function)	
Protective Ground	1	1	A Frame 101	1	1 ---- (Shield)	Chassis Ground. It may be isolated from Signal Ground.
Signal Ground	7	7	B Signal 102 GND	7	8 ---- (GND)	Common signal and DC power supply ground.
Transmitted Data	2	9 11	P TD(A) 103 S TD(B) 103	2 14	2 T(A) 9 T(B) (Transmit)	Serial digital data from DTE. In sync applications, the data translations must occur on the rising edge of the transmit clock.
Received Data	3	12 13	R RD(A) 104 T RD(B) 104	3 16	4 R(A) 11 R(B) (Receive)	Serial output from the modem receiver. In sync applications, the data translations occur on the rising edge of the clock.
Request to Send	4	4	C RTS 105	4 19	3 C(A) 10 C(B) (Control)	A positive level to FOM-40 when data transmission is desired.
Clear to Send	5	5	D CTS 106			A positive level from FOM-40 with delay, after receipt of Request to Send, and when FOM-40 is ready to transmit.

Table A-1. DTE Interface Signal Assignments (Cont.)

Signal Function	V.24	V.35		X.21		Description
	DB-25 Standalone and Card Cage	DB-25 Card Cage	34-Pin Standalone Pin Circuit	DB-25 Card Cage	DB-15 Standalone Pin Circuit (Function)	
Data Set Ready	6	6	E DSR 107			A positive level from FOM-40 when power is on, and FOM-40 is (a) not in digital loopback mode, or (b) has not received a remote loopback signal from the remote unit.
Data Terminal Ready	20	20	H DTR 108			Not used
Carrier Detect	8	8	F DCD 109	8 10	5 I(A) 12 I(B) (Indication)	A positive level from FOM-40, except when a loss of the received signal is detected or when Data Set Ready is negative.
External Transmit Clock	24	19 16	U SCTE(A) 113 W SCTE(B) 113	24 11	7 (A)* 14 (B)*	A serial data rate clock input from the data source. Positive clock translations must correspond to data transmissions.
Transmit Clock	15	14 10	Y SCT(A) 114 a SCT(B) 114	15 12	6 S(A) 13 S(B) (Signal Timing)	A transmit data rate clock for use by an external data source. Positive clock translations correspond to data translations.
Receive Clock	17	23 22	V SCR(A) 115 X SCR(B) 115			A receive data rate clock output used by an external data sink. Positive clock translations correspond to data translations.
Local Analog Loop	18	18	L and j			A control signal input, which, when on, sets FOM-40 into local analog loopback (V.54 Loop 3).
Remote Digital Loop	21	21	N and h			A control signal input which, when on, commands FOM-40 to send a remote loopback command (V.54 Loop 2) to the remote FOM-40.
Test Indicator	25	25	n and k			A Control Signal output from FOM-40; positive during any test mode.

A.2 RS-530 and V.36 Interface Connectors

The FOM-40 V.36 interface is provided via an adapter cable converting between 25-pin RS-530 connector and 37-pin V.36 connector. *Table A-2* lists the cable wiring.

Table A-2. Cable Converting between RS-530 and V.36 Interfaces, Pin Assignment

Signal Function	V.36, 37-Pin		RS-530, 25-pin	
	Pin	Circuit	Pin	Circuit
Protective Ground	1	Shield	1	
Signal Ground	19	SG	7	AB
DTE Common Return	37	SC		
DCE Common Return	20	RC		
Transmitted Data	4 22	SD (A) SD (B)	2 14	BA (A) BA (B)
Received Data	6 24	RD (A) RD (B)	3 16	BB (A) BB (B)
Request to Send	7 25	RS (A) RS (B)	4 19	CA (A) CA (B)
Clear to Send	9 27	CS (A) CS (B)	5 13	CB (A) CB (B)
Data Set Ready	11 29	DM (A) DM (B)	6 22	CC (A) CC (B)
Data Terminal Ready	12 30	TR (A) TR (B)	20 23	CD (A) CD (B)
Carrier Detect	13 31	RR (A) RR (B)	8 10	CF (A) CF (B)
External Transmit Clock	17 35	TT (A) TT (B)	24 11	DA (A) DA (B)
Transmit Clock	5 23	ST (A) ST (B)	15 12	DB (A) DB (B)
Receive Clock	8 26	RT (A) RT (B)	17 9	DD (A) DD (B)
Local Analog Loopback	10	LL	18	LL
Remote Loopback	14	RL	21	RL
Test Indicator	18	TM	25	TM

A.3 T1 Interface Connector

The balanced T1 interface of the standalone unit terminates in RJ-45 connector. *Table A-2* lists the T1 connector pin assignment.

Table A-3. T1 Balanced Connector Pinout

Pin	Function
1, 2	Receive (input)
4, 5	Transmit (output)

A.4 FOM-40/R with Ethernet Interface, DTE Connection

FOM-40/R with an Ethernet interface module uses a CIA/ETH interface adapter, which converts one DB-25 connector to an RJ-45 connector. If you intend to prepare a DB-25/RJ-45 adapter cable yourself, refer to *Figure A-1* and *Table A-4* for the pin designations and their assignment.

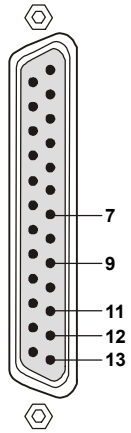

Figure A-1. Pin Designation in the DB-25 Connector of ASM-MN-214 Card Cage

Table A-4. DB-25 and RJ-45 Pinout, Ethernet

Pin		Function
RJ-45	DB-25	
3	13	RCV (+)
6	12	RCV (-)
1	11	XMT (+)
2	9	XMT (-)
–	7	GND

A.5 FOM-40/R with G.703 Codirectional Interface, DTE Connection

FOM-40/R with G.703 Codirectional interface uses an adapter cable that converts one DB-25 connector to an RJ-45 connector. Refer to *Figure A-1* and *Table A-4* for the pin designations and their assignment.

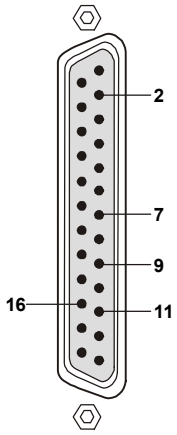

Figure A-2. Pin Designation in the DB-25 Connector of ASM-MN-214 Card Cage

Table A-5. DB-25 and RJ-45 Pinout, G.703 Codirectional

Pin		Function
RJ-45	**DB-25**	
3	9	RCV (+)
6	11	RCV (-)
4	2	XMT (+)
5	16	XMT (-)
2	7	GND

Appendix B
IR-ETH/QV Interface Module

B.1 Introduction

The IR-ETH/QV interface module replaces the IR-ETH/QN interface module. The IR-ETH/QV has improved functionality including two new priority queues. IR-ETH/QV includes a high-performance self-learning Fast Ethernet bridge. It connects to the LAN through a single 10BaseT or 100BaseT port, and operates in full- or half-duplex to provide a simple and cost-effective interconnection between 10/100BaseT LANs. The IR-ETH/QV interface module also supports IEEE 802.1p and IEEE 802.1q frames to enable VLAN applications.

The module automatically learns MAC addresses of the local LAN. Its LAN table stores up to 2,048 addresses with 5-minute automatic aging. Filtering and forwarding is performed at wire speed.

Figure B-1 shows a typical application using FOM-40 with IR-ETH/QV module.

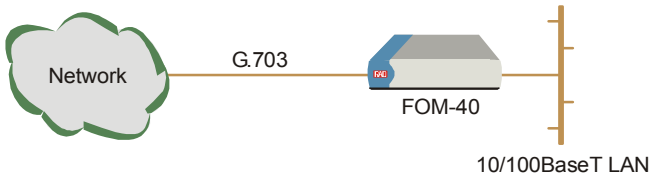

Figure B-1. Typical Application of FOM-40 with IR-ETH/QV Module

B.2 IR-ETH/QV Options

Standalone FOM-40

Figure B-2 shows the panel of the IR-ETH/QV module. *Table B-1* lists the module's RJ-45 connector pinout.

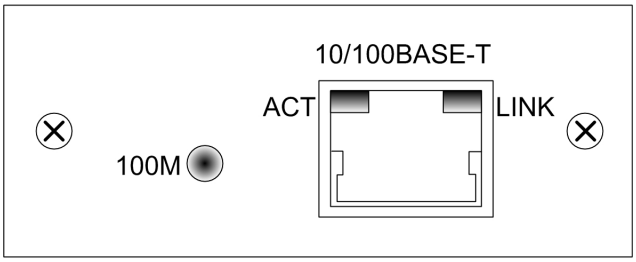

Figure B-2. Panel of IR-ETH/QV Module

Table B-1. RJ-45 Connector Pinout

Pin	Name	Function
1	RD (+)	Receive data positive
2	RD (–)	Receive data negative
3	TD (+)	Transmit data positive
6	TD (–)	Transmit data negative

B.3 Technical Specifications

Bridge	*LAN Table*	1,024 MAC addresses
	Aging	5 minute, automatic
	Filtering and Forwarding Rate	150,000 packets per second
	Buffer Size	170 frames
	Frame Size	1535 bytes (max)
LAN	*Standard*	IEEE 802.3/Ethernet V.2, IEEE 802.1q (relevant parts), 802.1p, 802.3x
	Data Rate	• 10BaseT: 10 Mbps • 100BaseT: 100 Mbps
	Transmission Line	4-wire, Category 5 UTP, 19 AWG to 26 AWG
	Line Code	• 10BaseT: Manchester • 100BaseT: MLT3
	Connector	RJ-45
WAN	*Protocol*	Point-to-point
	Data Rate	Up to 2048 kbps

B.4 Installation and Operation

Figure B-3 shows the DIP switch locations and the default settings of the IR-ETH/QV PCB.

Note *The screen print tables on the IR-ETH/QV PCB are look-up tables of the enabled function settings. The tables do not show the default settings. For example, MDI in OFF position, MDI is enabled.*

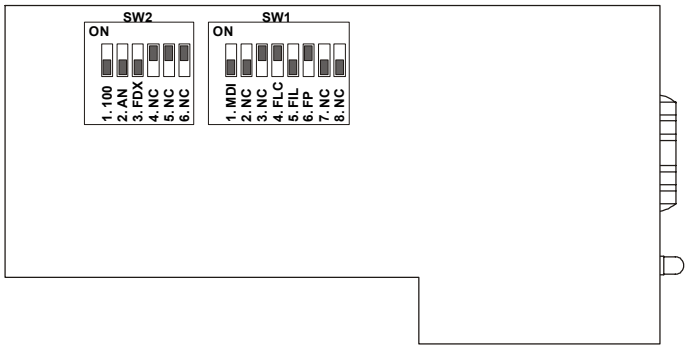

Figure B-3. SW1 and SW2 DIP Switch Locations

Setting the DIP Switches

Configure the IR-ETH/QV module by setting the DIP switches SW1 and SW2 in accordance with *Figure B-3*, *Table B-2* and *Table B-3*.

Note *After making changes in the flow control and LAN filtering switches, reset FOM-40 to make the changes take effect.*

Table B-2. DIP SW1 Switch Settings

Section	Name	Description	Possible Settings	Factory Setting
1	MDI	Automatic MDI/MDIX crossover	**ON** – Automatic MDI/MDIX crossover is disabled **OFF** – Automatic MDI/MDIX crossover is enabled	OFF
2, 3	NC	–	–	–
4	FLC	Flow control (full-duplex) / Backpressure (half-duplex) ***Note**: Flow Control (full duplex) is active only if autonegotiation is enabled*	**ON** – Flow control/Backpressure is enabled **OFF** – Flow control/Backpressure is disabled	ON
5	FIL	LAN filtering	**ON** – LAN filtering is disabled **OFF** – LAN filtering is enabled	OFF
6	FP	Fault propagation	**ON** – Fault propagation is disabled **OFF** – Fault propagation is enabled	ON
		***Note:** When fault propagation is enabled, the LAN interface shuts down if a failure is detected on the E1 line. When fault propagation is disabled, the link integrity is not influenced by the E1 behavior.*		
7, 8	NC	–	–	–

Note *Switches SW1/ 2, 3, 7, and 8 of the SW1 DIP switch are factory-set and must not be moved by the user.*

Table B-3. DIP Switch SW2 Settings

Section	Name	Description	Possible Settings	Factory Setting
1	100	LAN speed	**ON** – LAN speed is set to 10 Mbps **OFF** – LAN speed is set to 100 Mbps	OFF
2	AN	LAN autonegotiation	**ON** – LAN autonegotiation is disabled **OFF** – LAN autonegotiation is enabled	OFF
3	FDX	LAN duplex mode	**ON** – LAN half-duplex mode **OFF** – LAN full-duplex mode	OFF
4, 5, 6	NC	–	–	–

Notes

- Switches SW2/*4, 5, and 6 of the SW2 DIP switch are factory-set and must not be moved by the user.*
- *When autonegotiation is enabled, LAN speed and LAN duplex mode are configured automatically (switches SW2/1 and 3 are disabled).*

Backpressure and Flow Control

DIP switch SW1/4 enables or disables both backpressure and flow control.

When the IR-ETH/QV is set to half-duplex, backpressure is active, and when the IR-ETH/QV is set to full-duplex, flow control is active.

Note *Full-duplex flow control activation requires autonegotiation to be enabled.*

Backpressure is the term given when the buffer is filled from the LAN faster than it is able to transmit to the WAN. In order to prevent packet loss, collisions are forced into the LAN, which causes the link partners to go into back-off before attempting to retransmit. This reduces traffic passing through the interface.

Flow control is active only in full-duplex mode. When the buffer is filled from the LAN faster than it is able to transmit to the WAN, pause frames are sent to the LAN, ordering the LAN to stop for a time interval indicated by the pause frame until transmission starts again.

Note *To use the flow control option, the link partners (switches, etc.) should support flow control.*

LED Indicators

Table B-4 lists the IR-ETH/QV LED indicators and describes their functions.

Table B-4. IR-ETH/QV LED Indicators

LED	Color	Function
LINK	Green	ON – LAN is connected
ACT	Yellow	Blinks – Transmit/receive activity is detected on the Ethernet link
100M	Green	ON – LAN is operating at 100 Mbps

Connecting the LAN

Use either a straight cable or a cross-cable for the LAN connection.
Use a cross-cable when connecting to a port that does not implement the crossover function internally. Otherwise, use a straight cable.

Note *Hubs usually implement the crossover function internally, while NICs and other devices do not.*

Appendix C
IR-G.703/CO Interface Module

C.1 Introduction

IR-G.703/CO is an interface module for RAD modems that converts G.703 64 kbps codirectional signals to TTL levels. The converted data is sent over the modem link using the modem modulation technique and converted back at the other end into G.703 64 kbps codirectional signals, or into any other digital interface signal possible. IR-G.703/CO is available with two types of physical connections: a terminal block or an RJ-45 (see *Table C-1* for the RJ-45 connector pinout).

Figure C-1 illustrates the panel of the IR-G.703/CO interface module.

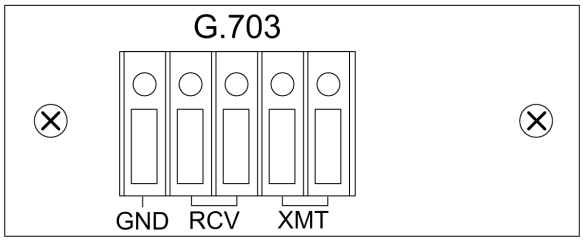

Figure C-1. Panel of the IR-G.703/CO Module

Table C-1. RJ-45 Connector Pinouts

Pin	Function
3	RCV (+)
6	RCV (-)
4	XMT (+)
5	XMT (-)
2	GND

C.2 Selecting the IR-G.703/CO Timing

The IR-G.703/CO interface module can operate with EXT or INT/RCV timing to match the clock reference of the FOM-40 modem. The clock selection is made using the JP1 jumper located on the module board (see *Figure C-2*).

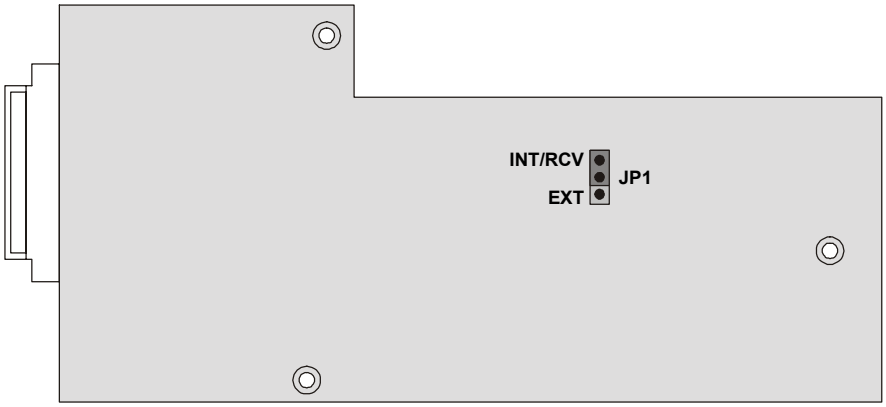

Figure C-2. JP1 Location on the IR-G.703/CO Board

EXT Timing

The EXT clock is used in applications where the G.703 network provides system timing. The IR-G.703/CO module has an internal buffer that compensates for the phase delay introduced into the system by the line delay between the two modems. The buffer is an 8-bit FIFO connected as shown in *Figure C-3*.

If the FOM-40 modem is set to external timing, configure the IR-G.703/CO module to the EXT clock.

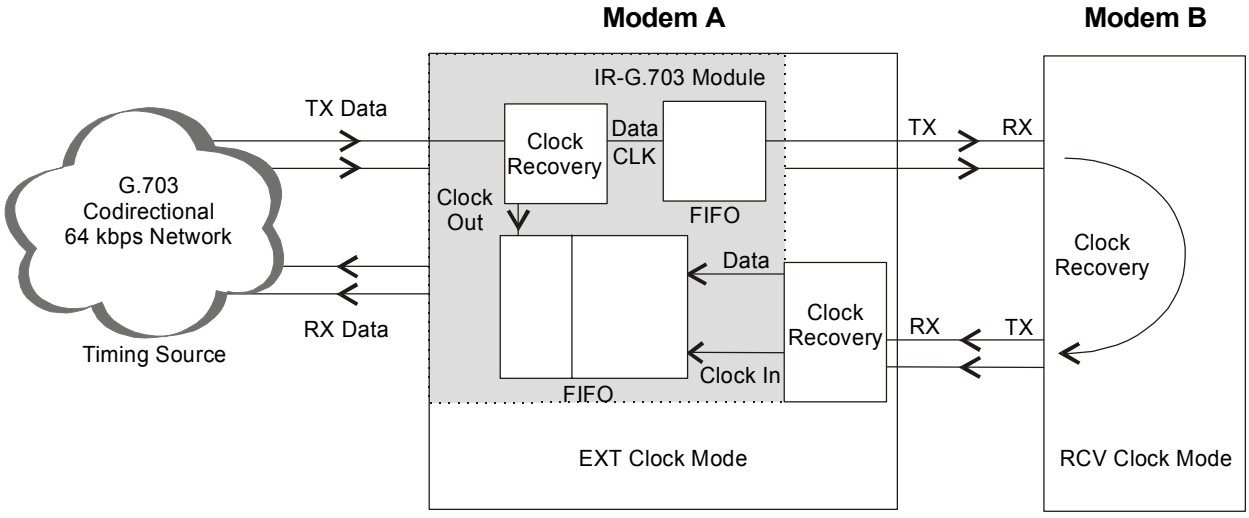

Figure C-3. IR-G.703/CO EXT Timing

INT/RCV Timing

The INT/RCV clock is used in applications that recover the clock signal from the modem link. This mode is used when the attached equipment has a G.703 codirectional interface but cannot produce clock signals. The module has an 8-bit FIFO buffer to compensate for the phase delay introduced by the G.703 device. *Figure C-4* illustrates the buffer connection and the required application setup.

If the FOM-40 modem is set to the internal or receive timing, configure the IR-G.703/CO module to the INT/RCV clock.

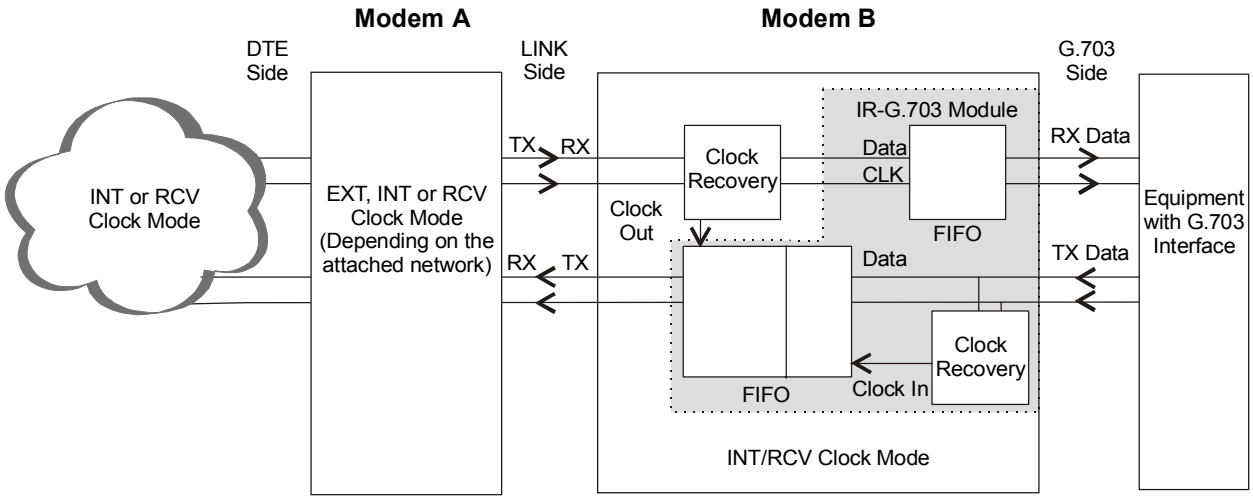

Figure C-4. IR-G.703/CO INT/RCV Timing

Appendix D
IR-X.21Interface Module

D.1 Introduction

IR-X.21 is an interface module that converts X.21 signals to TTL levels. The converted data is sent over the modem link, using the modem modulation technique, and is converted back at the other end into X.21 signals, or into any other digital interface signal.

Figure D-1 shows a typical application of FOM-40 with IR-X.21 interface module.

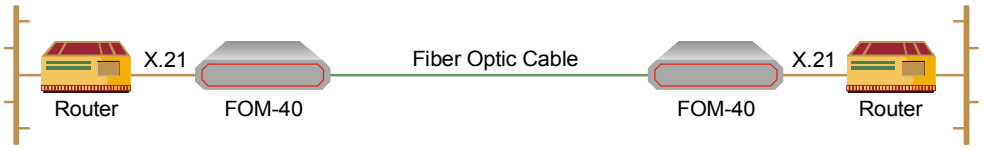

Figure D-1. Typical Application of FOM-40 with IR-X.21 Module

Standalone FOM-40 Connector

Figure D-2 shows the IR-X.21 interface module. *Table D-1* lists the module DB-15 connector pin assignment.

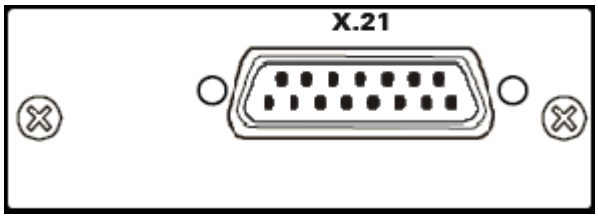

Figure D-2. IR-X.21 Module

Table D-1. IR-X.21 Connector Pin Assignment

Pin	ID	Function
1	Shield	Chassis connection
2	A	Transmit signal A
3	A	Control A
4	A	Receive A
5	A	Indication A
6	A	Signal timing A
7	A	External Timing
8	GND	Common

Table D-1. IR-X.21 Connector Pin Assignment (Cont.)

Pin	ID	Function
9	B	Transmit B
10	B	Control B
11	B	Receive B
12	B	Indication B
13	B	Signal Timing B
14	B	External Timing

D.2 Selecting the IR-X.21 Timing

IR-X.21 interface module supports two clock modes:

- EXT (External)
- INT/LBT (Internal/Receive).

Set the IR-X.21 clock to match the timing selected for the FOM-40 modem. The clock settings are made using the JP2 jumper located on the IR-X.21 board, as shown in *Figure D-3*.

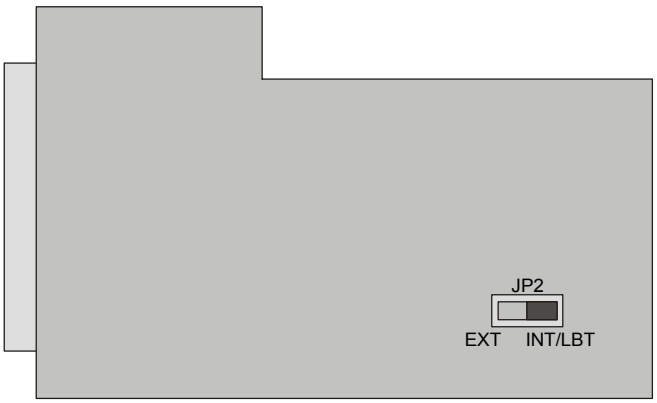

Figure D-3. IR-X.21 Module Layout

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Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: FOM-40

Publication Number: 281-200-07/05

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

What did you like about the manual?

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Error Report

Type of Error(s) or Problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
- ❒ Illogical flow of information
- ❒ Style (spelling, grammar, references, etc.)
- ❒ Appearance
- ❒ Other _____

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

_____

_____

_____

_____

Please add any comments or suggestions you may have.

_____

_____

_____

You are:

- ❒ Distributor
- ❒ End user
- ❒ VAR
- ❒ Other _____

Who is your distributor? _____

Your name and company: _____

Job title: _____

Address: _____

Direct telephone number and extension: _____

Fax number: _____

E-mail: _____

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